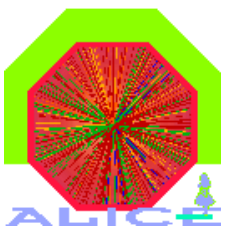
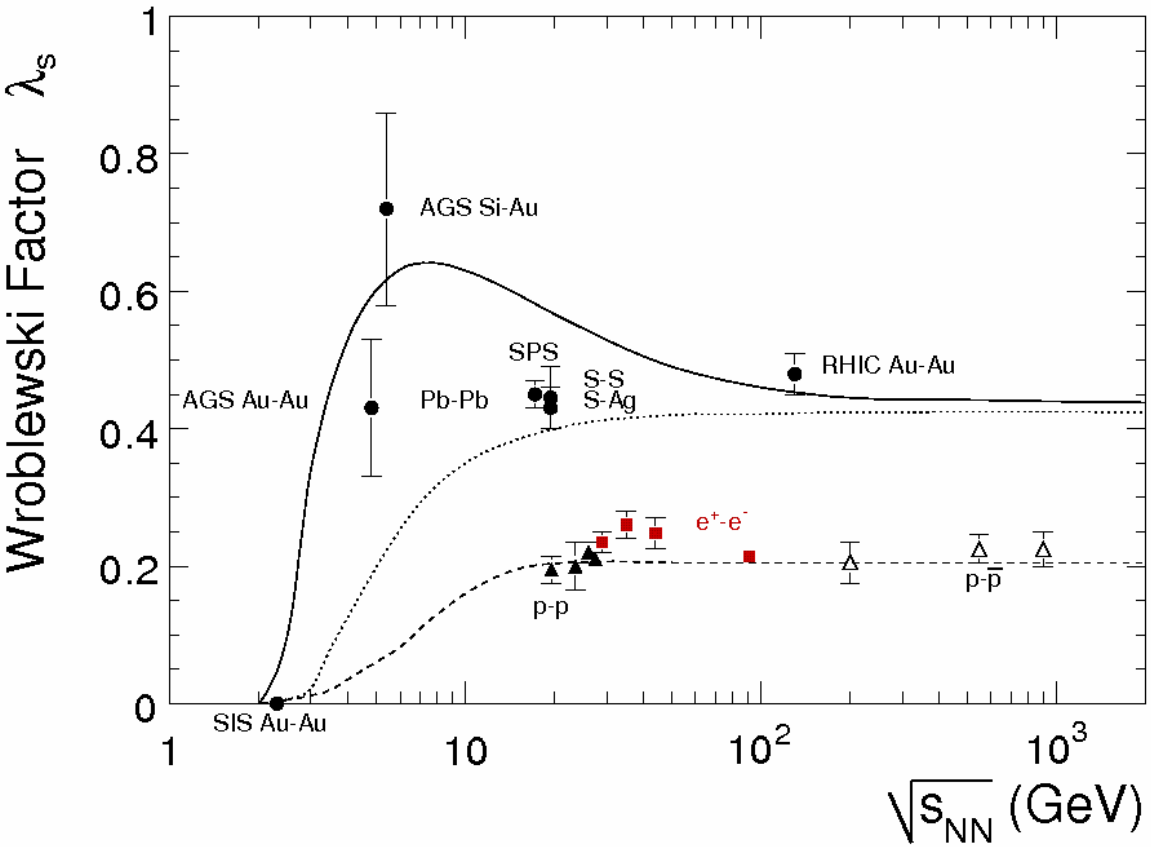
Strange Prospects for LHC energies

1. Strangeness at LHC energies — Extrapolations / Motivations
2. Strange probes with ALICE — Detector and Simulations
3. First p+p Collisions and beyond — First measures to target

Boris HIPPOLYTE for the ALICE Collaboration,
IPHC Strasbourg



Wroblewski factor extrapolation to LHC energies



Wroblewski factor:

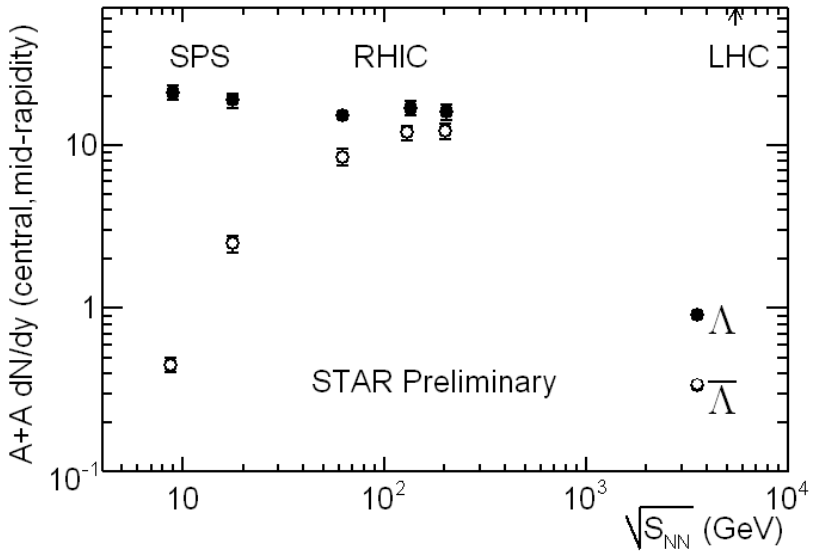
$$\lambda_s \equiv 2\frac{\langle s\bar{s}\rangle}{\langle u\bar{u}\rangle+\langle d\bar{d}\rangle}$$

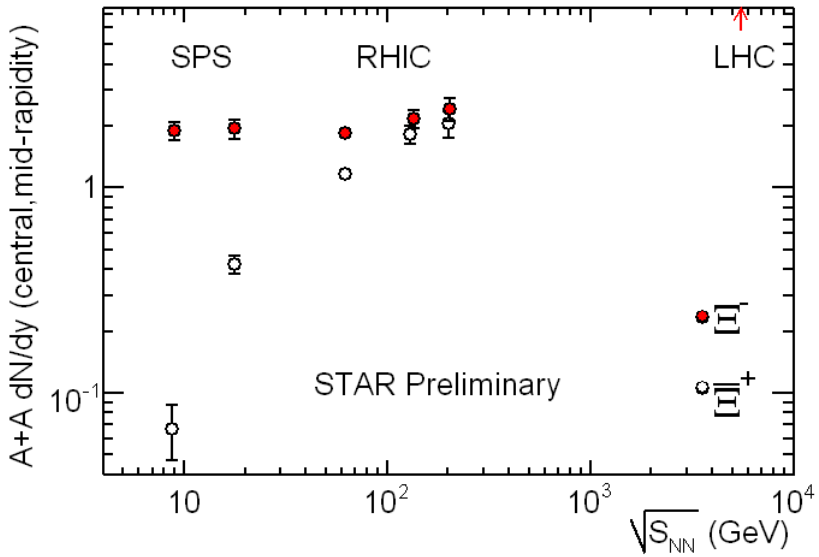
Extrapolation at the LHC
A+A ~0.45
p+p ~0.25

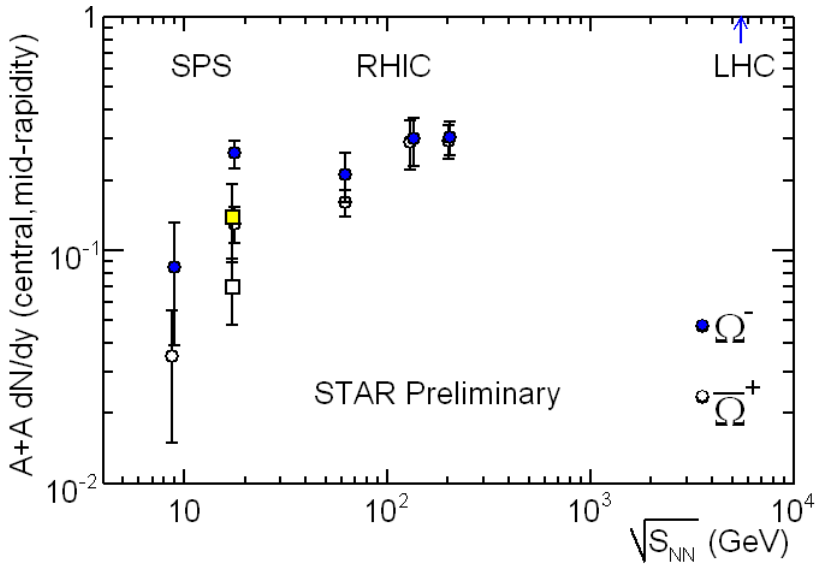
Data compilation using **Becattini et al**., PR C64 (2001) 024901, hep-ph/0002267 and references therein

Using thermal model description with corresponding system formalism (canonical or grand-canonical), extrapolation is straightforward.

Excitation functions of hyperons yields in A+A







dN/dy extrapolations at the LHC

for Λ : 10~30

for Ξ : 3~6

for Ω : 0.4~0.7

Expected modifications

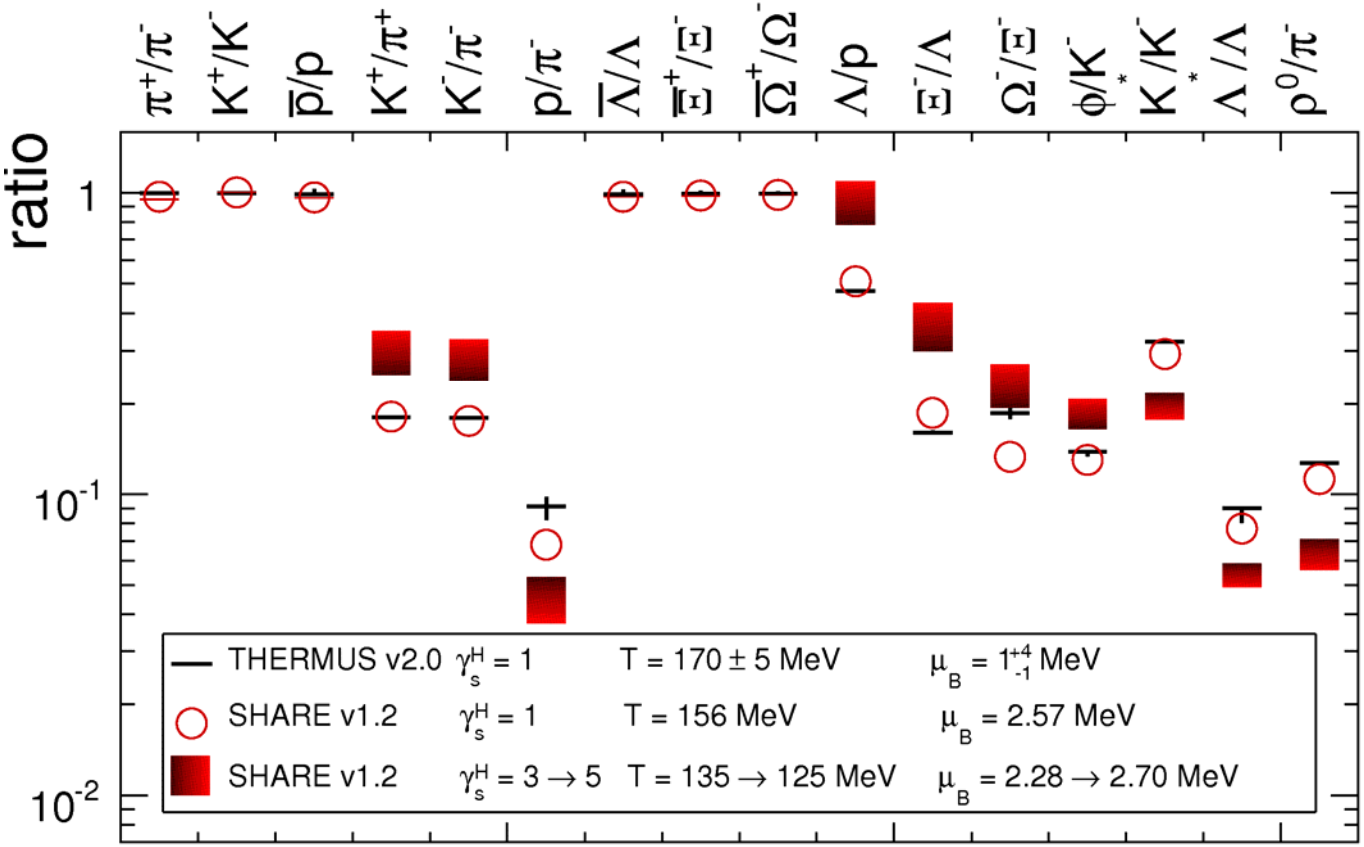
total multiplicity scaling

non-equilibrium scenario

Equilibrium vs non−equilibrium scenarii in A+A

Eq. [Oeschler et al., to be published]
[Andronic et al., nucl-th/0511071]
Non Eq. [Rafelski et al., Eur. J. Phys. C45 (2006) 61]

ALICE Estimates : Equilibrium vs Non Eq. particle ratios



Calculations from
Kraus et al., (Eq.)
Rafelski et al., (Non Eq.)

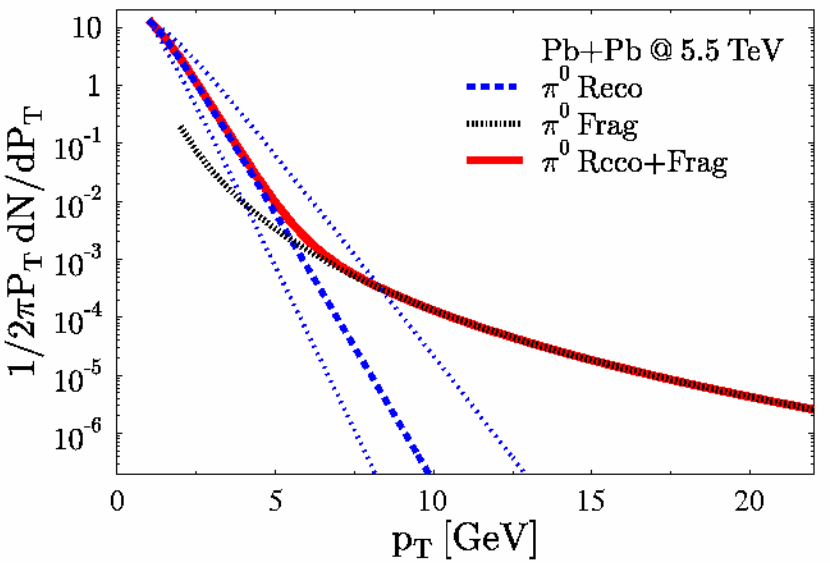
Expectations at the LHC energies (eq.):
T_{ch} ~170 MeV
μ_B ~1 MeV

Scenarii for γ_s

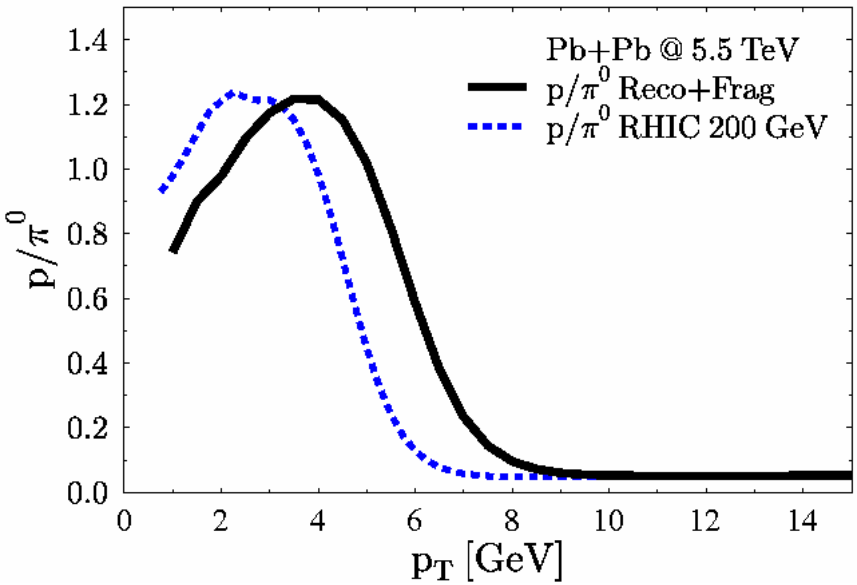
Hadronization via coalescence at LHC energies

Fries and Müller, EJP C34, S279 (2004)

Calculation implies assumption on transverse radial flow extrapolation



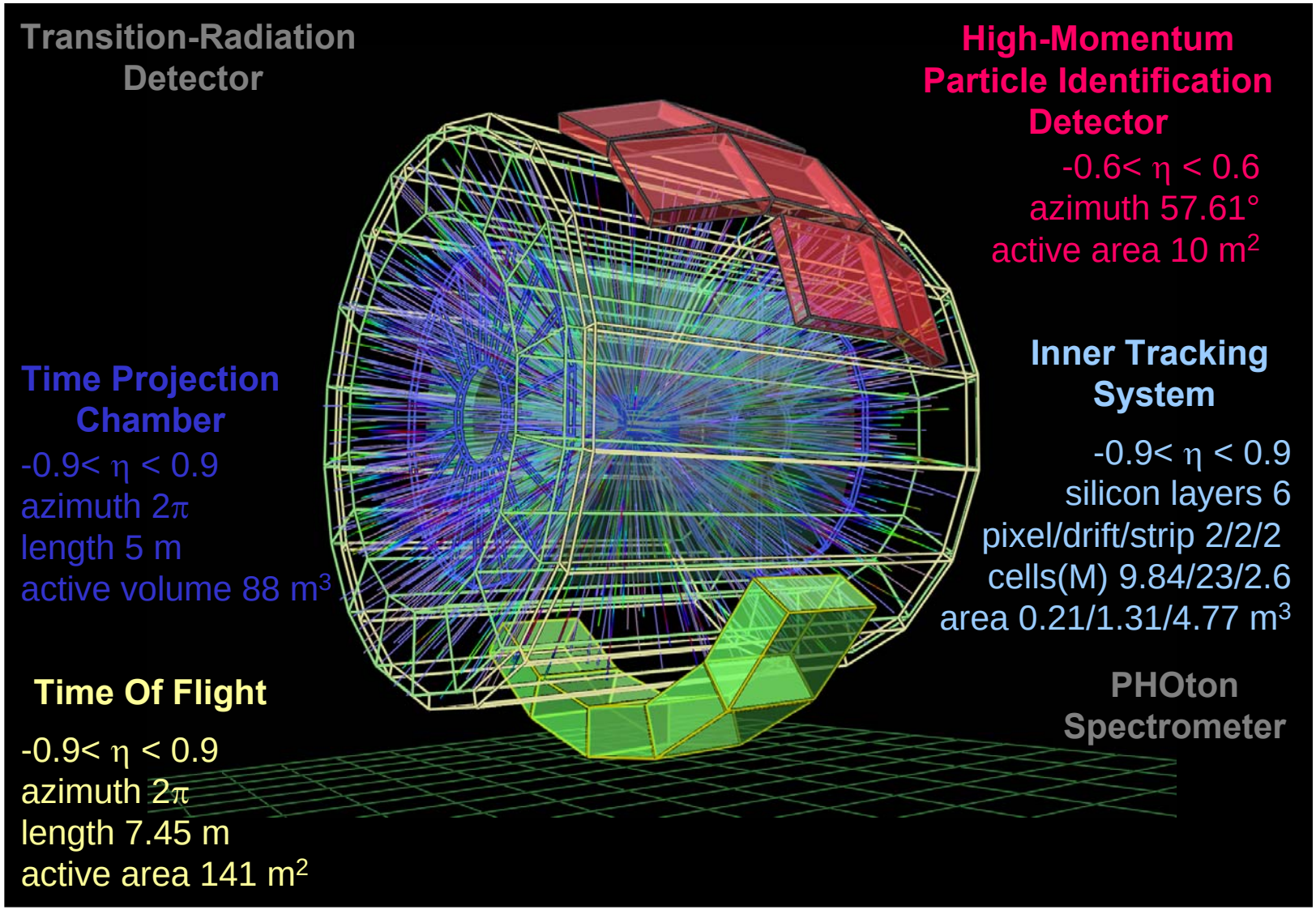
Amplitude for mixed ratio is the same at LHC than for RHIC but the limit is pushed to higher p_T



Probing baryon/meson differences at LHC energies implies PID over a large p_T range and ALICE is perfectly designed for this.

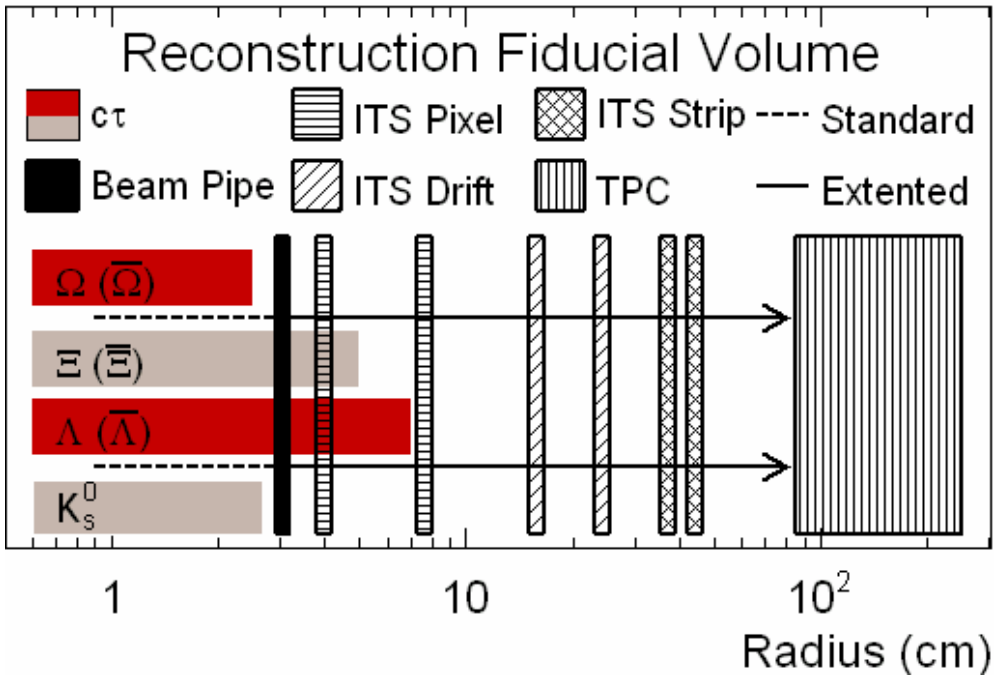
But first ALICE data will be elementary collisions ⇨ check magnitude of this behaviour then assume coalescence mechanisms if needed.

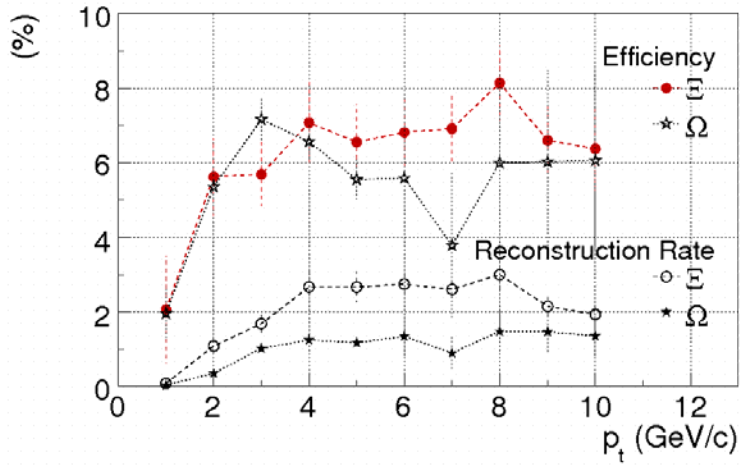
The central detectors of the ALICE experiment

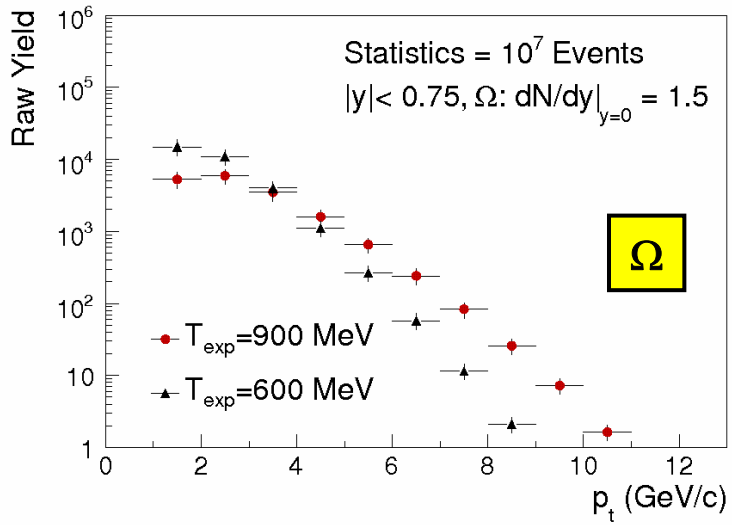


Fiducial volume and reconstruction strategies

Standard / extended fiducial volume leading to high purity / efficiency for strange particle reconstruction







Expected raw spectra extrapolated to 10^7 central events (first year Pb+Pb data).

PID Range of ALICE at mid−rapidity

Estimates as in the Physics Performance Report Vol.II
for one year of Pb+Pb data-taking (central events)

10^7 central Pb+Pb events

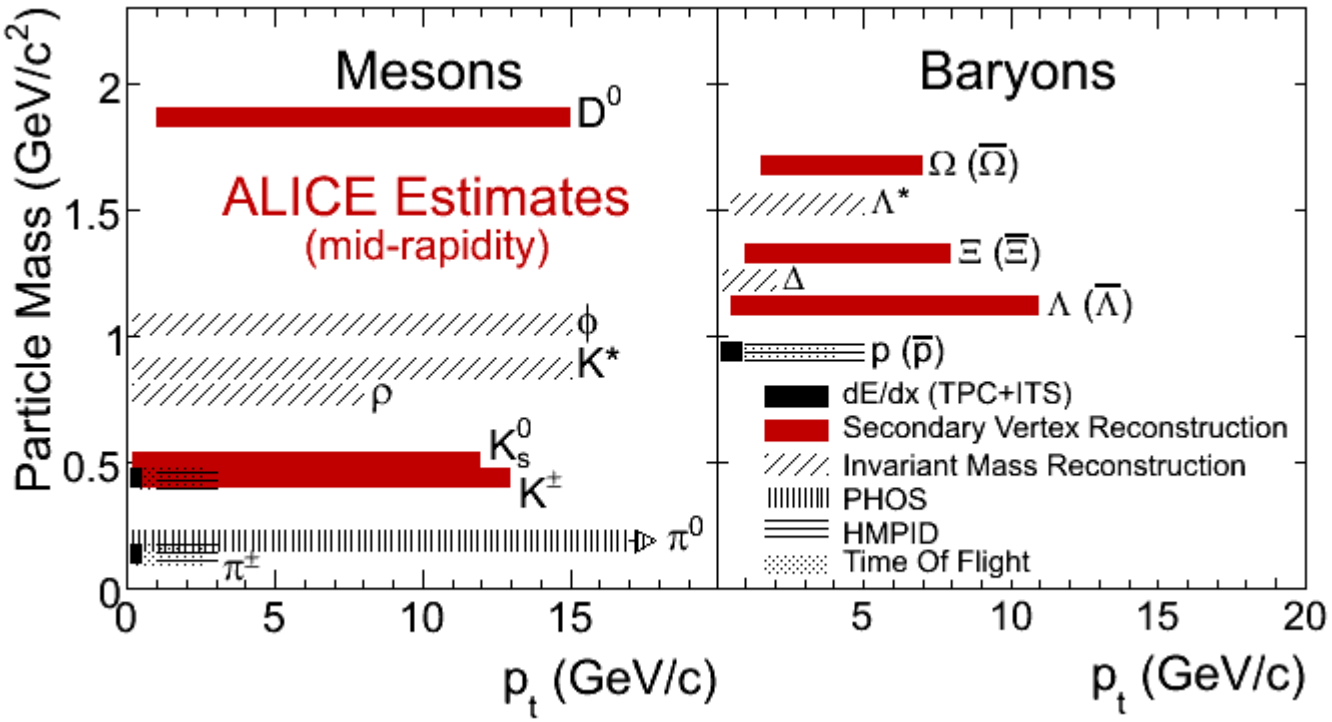
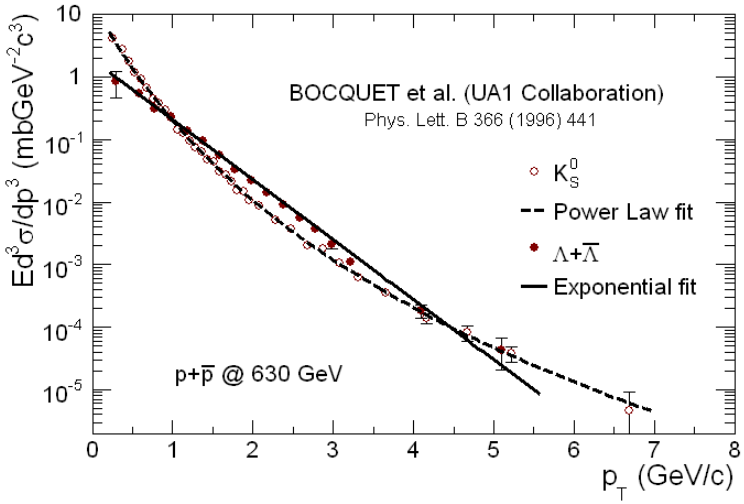
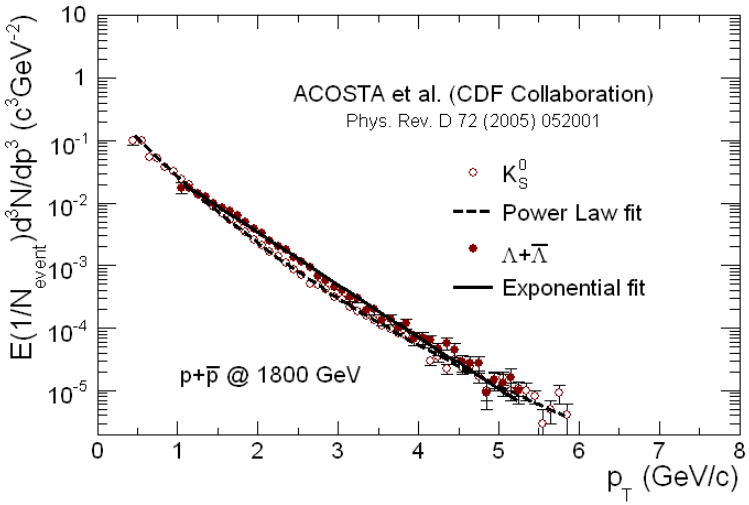


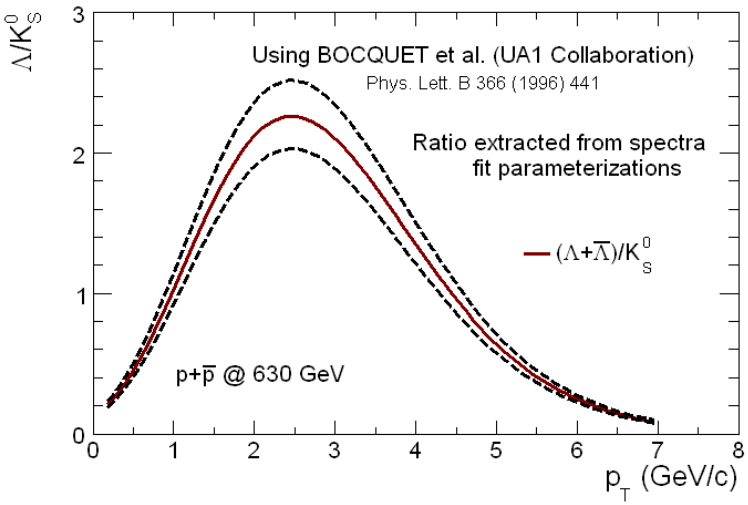
Figure 6.87: Tranverse momentum ranges for particle identification at mid-rapidity using the main sub-detectors of the ALICE experiment. Each range is an estimate for 10 M most central events. Mesons and baryons p_t ranges are shown in the left panel and right panel respectively. Arrows are specified when the PID range exceeds that of the figure i.e. 20 GeV/c.

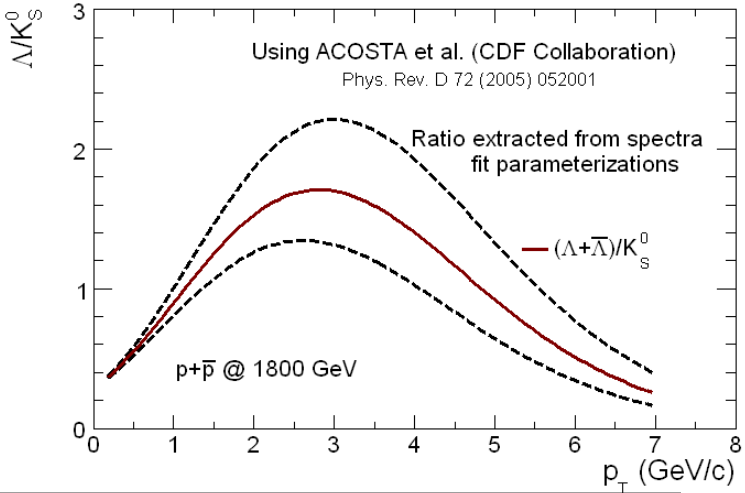
Baryon/Meson p_T ratio in $\bar{p}$+p @ 630 and 1800 GeV

Extracting mixed ratio from UA1 spectra (1996) and from CDF spectra (2005)







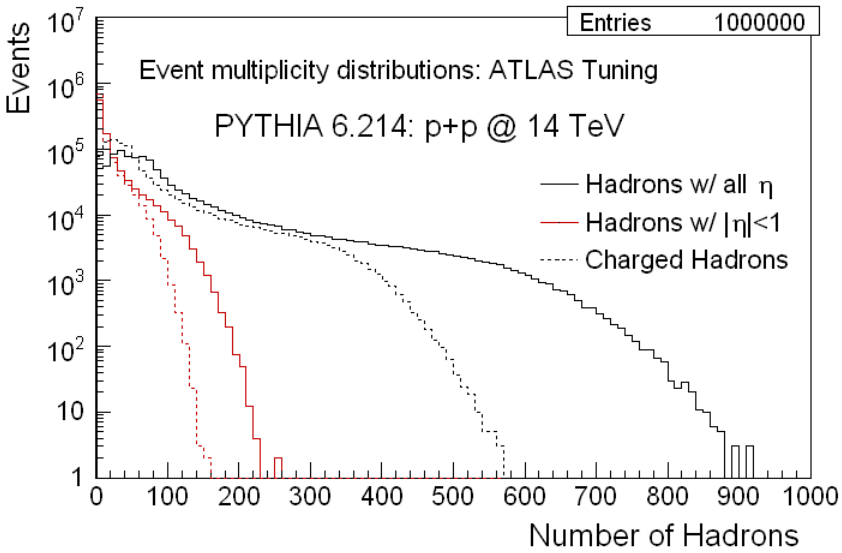


Ratio vs p_T already surprisingly high in p+p data at high energies

Extrapolations and PYTHIA: p+p @ 14 TeV

LHC extrapolation: “ATLAS tuning” min. bias and underlying event

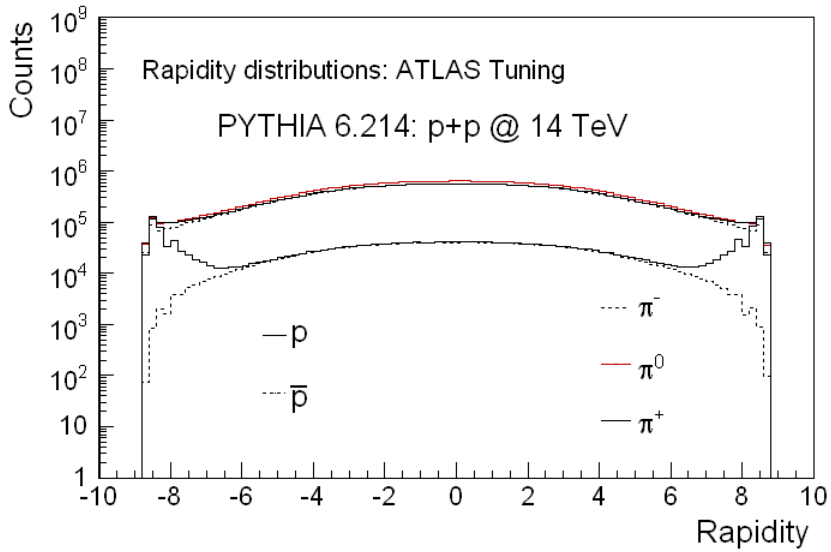
simulation samples: 1M p+p events



Different sets of parameters (tuning) for LHC energies:

a) extrapolation of Tevatron data (CDF tune A);

b) data for jets and high-p_T phenomena;



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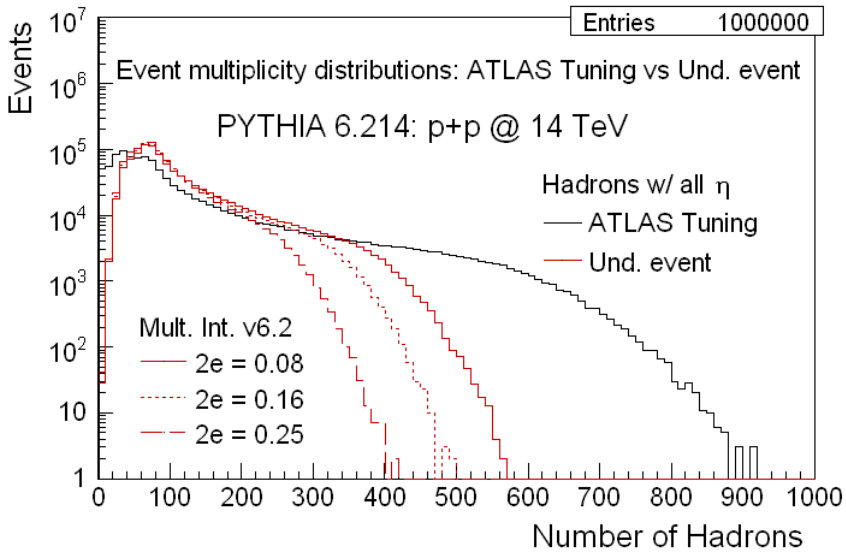

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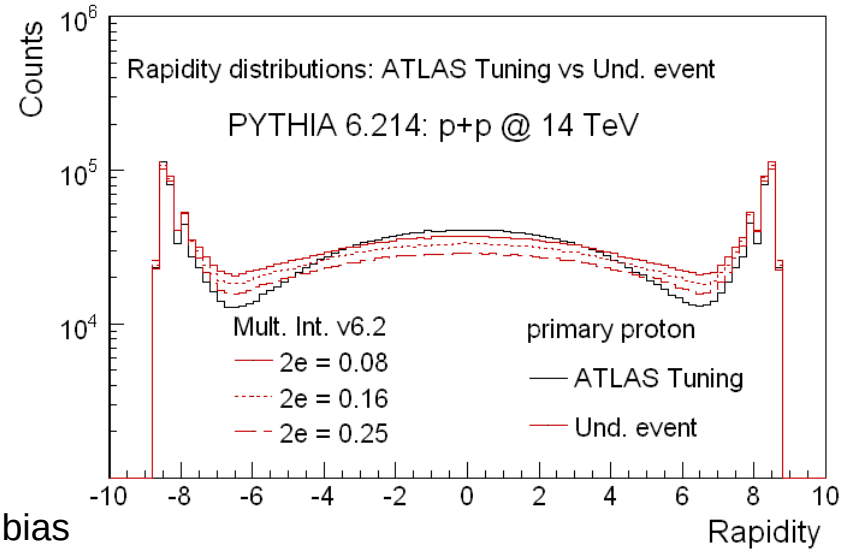


Low p_T description implies specific treatment

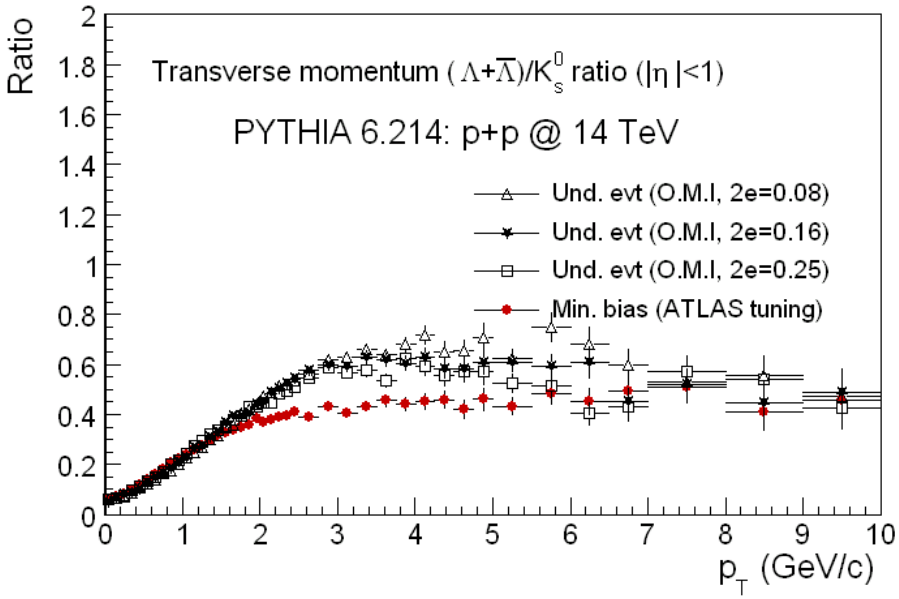
a) O.M.I (v6.2): different pars for und. event & min. bias

⇨ **first PYTHIA v6.2 description of soft domain @ LHC (different rescaling factor for und. event)**

b) N.M.I in PYTHIA 6.3: multiple part-part int. (+ i/fsr)

PYTHIA Baryon/Meson p_T ratio: p+p @ 14 TeV

Ratios and differences between min. bias and underlying event description



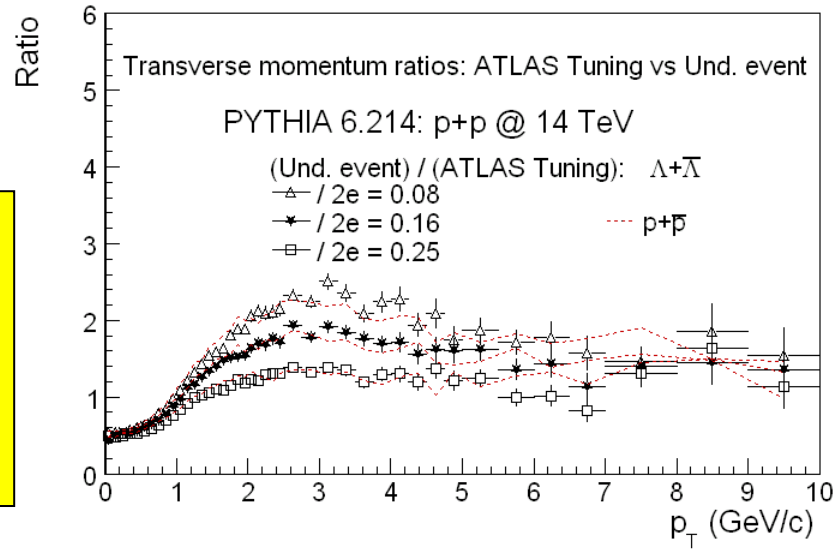
Checking uncertainty for parameters energy dependence:

PYTHIA authors' suggestions : **2ε~0.08 ⇨ 0.25**

Comparison between ATLAS tuning and underlying event description

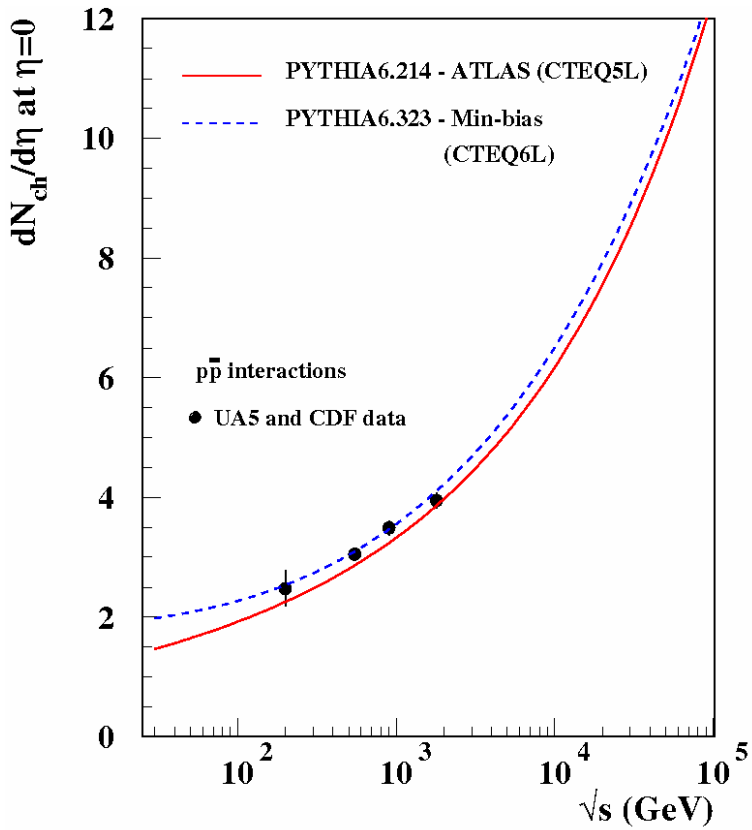
Little **light/strange** flavor dependence in this region

Underlying event description **needed/enough** for production of hadrons in intermediate p_T region ?



Recent extrapolation from the Les Houches Working Group

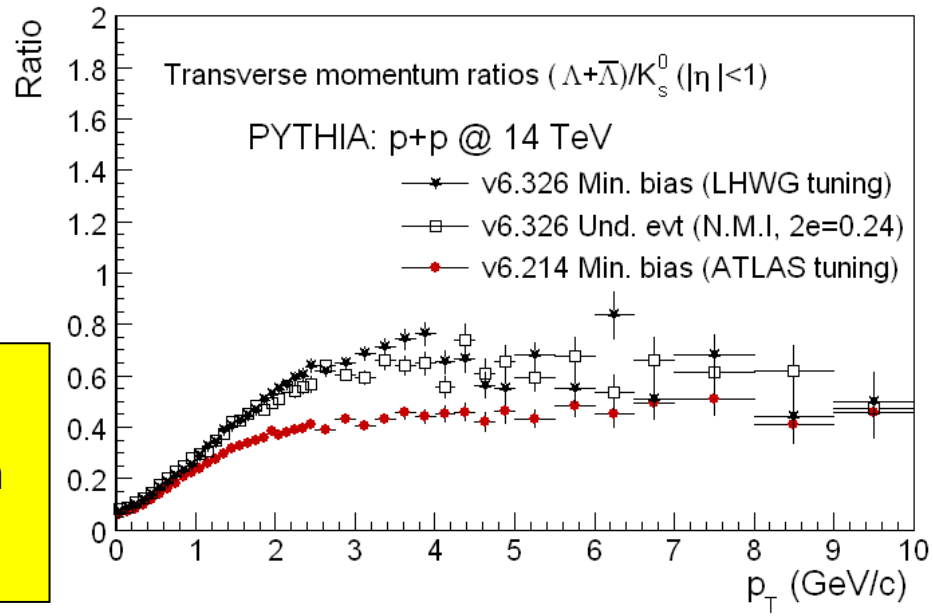
preprint hep-ph/0604120



Major evolutions for LHC extrapolation:

PYTHIA: **v6.2** ⇨ **v6.3**
New multiple interaction (N.M.I) treatment
⇨ part.-part. interactions and i/fsr

PDF: **CTEQ5** ⇨ **CTEQ6**
main change in gluon distribution function
⇨ visible at low Q^2



Better but still missing a factor of ~2 wrt RHIC ⇨ UA1 ⇨ CDF extrapolations ⇨ investigating NLO contribution, baryon creation mechanisms (diquark, popcorn scenario, and gluonic baryon junctions).

Conclusion

Using strangeness as a powerfull probe at LHC energies with the PID capabilities of the ALICE experiment

a) Equilibrium vs non-equilibrium scenario
b) Hadronization and coalescence validity at LHC

⇨ **strange particles (specific probes and PID) !**

First measurements of strange particles in p+p to obtain:

1) Interesting for studying baryon production mechanisms
2) Constrains for underlying event description
3) Set references for Pb+Pb (mandatory)

WARNING: minimum bias trigger for p+p !